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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/885,409	06/21/2001	Jamal Ramdani	210148US99	3933

22850 7590 06/27/2002

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EXAMINER
NGUYEN, DAO H

ART UNIT	PAPER NUMBER
2818	

DATE MAILED: 06/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/885,409	Applicant(s) RAMDANI ET AL.	
	Examiner Dao H Nguyen	Art Unit 2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 June 2001* .

2a)☐ This action is FINAL. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. In response to the communications dated 06/21/2001, claims 1-20 are active in this application.

Specification

2. The abstract of the disclosure is objected to because it contents the reference characters " 21' ", which is not shown in any figure of the drawing. It appears that " 21' " should be changed to – 20' -- Appropriate correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

4. Claims 1,2,4,9-12,19, and 20 are rejected under 35 U. S. C. § 102 (e) as being anticipated by U.S. Patent No. 6,291,319 to Yu et al.

Regarding to claims 1, 9, and 19, Yu et al. disclose a method of fabricating a semiconductor structure, as shown in figures 1-12 and described in column 4, line 66 to colun : 8, line 13, comprising the steps of:

providing a silicon substrate 10 having a surface;

forming by chemical vapor deposition (column 5, line 17-19), which could be atomic layer deposition (See column 3, lines 3-39. See further U.S. Patent No. 6,200 893 to Sneh, lines 31-52, or U.S. Patent No. 6, 346,477 to Kaloyeros et al., lines 49-55) a single crystal material interface, or a monocrystalline seed layer, on the surface of the silicon substrate, the seed layer formed of a silicate material comprising of silicon, nitrogen, oxygen, and a metal (See column 5, lines 3-5), which could be combined to form any of strontium silicon oxide ($SrSiO_4$), zirconium silicon oxide ($ZrSiO_4$), and hafnium silicon oxide (Hf SiO_4); and

forming by atomic layer deposition one or more layers of a monocrystalline high dielectric constant oxide on the seed layer, the material of the layer of high dielectric constant oxide comprise of silicon, nitrogen, oxygen, and a metal (See column 5, lines 3-5), which could be combined to form any of hafnium oxide (HfO_2), zirconium oxide (ZrO_2), strontium titanate ($SrTiO_3$), lanthanum oxide (La_2O_3), yttrium oxide (Y_2O_3), titanium oxide (TiO_2), and aluminum oxide (Al_2O_3).

See further column 4, line 64 to column 5, line 7, and column 5, lines 36-39.

Regarding to claim 2, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of providing the substrate 10 includes the

step of providing a substrate having formed thereon a silicon oxide. See column 2, lines 26-30.

Regarding to claim 4, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of providing a substrate includes providing a substrate having a layer of hydrogen (hydrogen terminated Si surface) formed thereon by hydrogen passivation. See column 2, line 31.

Regarding to claim 10, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of forming by atomic layer deposition the seed layer of a silicate material includes forming the seed layer of a silicate material comprising of silicon, nitrogen, oxygen, and a metal (See column 5, lines 3-5), which could be combined to form any of strontium silicon oxide ($SrSiO_4$), zirconium silicon oxide ($ZrSiO_4$), and hafnium silicon oxide ($Hf SiO_4$).

Regarding to claim 11, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of forming by atomic layer deposition one or more layers of a monocrystalline high dielectric constant oxide on the seed layer includes forming the layer of high dielectric constant oxide material comprising of silicon, nitrogen, oxygen, and a metal (See column 5, lines 3-5), which could be combined to form any of hafnium oxide (HfO_2), zirconium oxide (ZrO_2), strontium

titanate ($SrTiO_3$), lanthanum oxide (La_2O_3), yttrium oxide (Y_2O_3), titanium oxide (TiO_2), and aluminum oxide (Al_2O_3).

Regarding to claim 12, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of providing a substrate includes the step of providing a substrate having formed thereon a silicon oxide. See column 2, lines 26-30.

Regarding to claim 20, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of providing a silicon substrate having a surface includes the step of providing one of a silicon substrate having formed thereon the surface a layer of silicon oxide (see column 2, lines 26-30), or a layer of hydrogen formed by hydrogen passivation (See column 2, line 31).

Claim Rejections - 35 U.S.C. § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 3, 5-8, and 13-18 are rejected under 35 U.S.C. 103 (a) as being unpatentable over U.S. Patent No. 6,291,319 to Yu et al., in view of the following remarks.

Regarding to claim 3, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of forming by atomic layer deposition a seed layer further includes the step of depositing a layer of a metal oxide onto a surface of the silicon oxide, and reacting the metal oxide and the silicon oxide to form a monocrystalline silicate. See column 3, lines 16-28, and column 4, line 65 to column 5, line 5.

Though Yu et al. do not mention about flushing the layer of metal oxide with an inert gas. It would have been obvious at the time the invention was made to a person having ordinary skill in the art that in atomic layer deposition, purging or flushing the reactant (the metal layer in this case) with an inert gas prior to reacting the metal oxide and the silicon oxide to form a monicrystalline silicate is necessary and required. See further U.S. Patent No. 6,124,158 to Dautartas et al., the abstract and column 3, lines 22-49.

Regarding to claims 5 and 6, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of forming by atomic layer deposition a monocrystalline seed layer further includes the step of desorbing the layer of hydrogen formed on the substrate (column 2, lines 29-31), exposing the silicon substrate to a

silicon precursor and at least one metal precursor thereby forming a layer of a silicon and a metal on the surface of the silicon substrate (column 2, lines 35-45).

Yu et al. do not mention about flushing the layer of silicon with an inert gas to remove any excess silicon and metal precursor material, nor do Yu et al. discuss about exposing the surface of the layer of silicon to at least one of oxygen (0_2) with or without plasma, water (H_2O), nitrous oxide (N_2O), or nitric oxide (NO) to oxidize the layer of silicon and metal to form a single oxidized monolayer, and flushing the oxidized monolayer with an inert gas.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art that in atomic layer deposition, the layer of silicon with an inert gas, exposing the surface of the layer of silicon to at least one of oxygen (0_2) with or without plasma, water (H_2O), nitrous oxide (N_2O), or nitric oxide (NO) to oxidize the layer of silicon and metal to form a single oxidized monolayer, and repeatedly flushing the monolayer with an inert gas to form a monolayer or a monocrystalline are necessary and required. See further U.S. Patent No. 6,124,158 to Dautartas et al., the abstract and column 3, lines 22-60.

Regarding to claims 7, and 8, though Yu et al. do not specifically discuss about the processes of forming one or more layers of a monocrystalline high dielectric constant oxide, it would have been obvious at the time the invention was made to a person having ordinary skill in the art that since the layers of a monocrystalline high

dielectric constant oxide is similar to the seed layer, the processes for forming them, hence, are similar or the same, and these processes are discussed above.

Regarding to claim 13, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of forming by atomic layer deposition a seed layer further includes the step of depositing a layer of a metal oxide onto a surface of the silicon oxide, and reacting the metal oxide with the silicon oxide to form the silicate material comprising silicon, nitrogen, oxygen, and metal (see column 5, lines 3-5), which obviously could be combined to form any of strontium silicon oxide ($SrSiO_4$), zirconium silicon oxide ($ZrSiO_4$), and hafnium silicon oxide ($HfSiO_4$). See also column 3, lines 16-28, and column 4, line 65 to column 5, line 5.

Though Yu et al. do not mention about flushing the layer of metal oxide with an inert gas. It would have been obvious at the time the invention was made to a person having ordinary skill in the art that in atomic layer epitaxy, or atomic layer deposition, purging or flushing the reactant, the metal layer in this case, with an inert gas prior to reacting the metal oxide and the silicon oxide to form a monocrystalline silicate is necessary and required. See further U.S. Patent No. 6,124,158 to Dautartas et al., the abstract and column 3, lines 22-49.

Regarding to claim 14, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of providing a substrate includes providing a

substrate having a layer of hydrogen (hydrogen terminated Si surface) formed thereon by hydrogen passivation. See column 2, line 31.

Regarding to claims 15 and 16, Yu et al. disclose the method of fabricating a semiconductor structure, wherein the step of forming by atomic layer deposition a monocrystalline seed layer further includes the step of desorbing the layer of hydrogen formed on the substrate (column 2, lines 29-31), exposing the silicon substrate to a silicon precursor and at least one metal precursor thereby forming a layer of a silicon and a metal on the surface of the silicon substrate (column 2, lines 35-45).

Yu et al. do not mention about flushing the layer of silicon with an inert gas to remove any excess silicon and metal precursor material, nor do Yu et al. discuss about exposing the surface of the layer of silicon to at least one of oxygen (0_2) with or without plasma, water (H_2O), nitrous oxide (N_2O), or nitric oxide (NO) to oxidize the layer of silicon and metal to form a single oxidized monolayer, and flushing the oxidized monolayer with an inert gas.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art that in atomic layer deposition, the layer of silicon with an inert gas, exposing the surface of the layer of silicon to at least one of oxygen (0_2) with or without plasma, water (H_2O), nitrous oxide (N_2O), or nitric oxide (NO) to oxidize the layer of silicon and metal to form a single oxidized monolayer, and repeatedly flushing the monolayer with an inert gas to form a monolayer or a monocrystalline are necessary

and required. See further U.S. Patent No. 6,124,158 to Dautartas et al., the abstract and column 3, lines 22-60.

Regarding to claims 17 and 18, though Yu et al. do not specifically discuss about the processes of forming one or more layers of a monocrystalline high dielectric constant oxide, it would have been obvious at the time the invention was made to a person having ordinary skill in the art that since the layers of a monocrystalline high dielectric constant oxide is similar to the seed layer, the processes for forming them, hence, are similar or the same, and these processes are discussed above.

Conclusion

7. When responding to the office action, Applicants are advised to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dao Nguyen whose telephone number is (703) 305-1957. The examiner can normally be reached on Monday-Friday 9:00am - 6:00pm. If

attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (703) 308-4910. The fax numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Dao H. Nguyen
Art Unit 2818
June 19, 2002

HOAI HO
PRIMARY EXAMINER